Advanced Capabilities for Emergency Response Operations (ACERO)

CWSF – WSFM committee meeting, 20230216

Challenges Integrating New Technologies

- Diverse set of stakeholders with various needs, constraints, and desires that require interoperability
- Different phases of the wildfire lifecycle create unique challenges and require a variety of solutions
- Technology solutions must be simple and easy to use
- Technology solutions must interoperable and scalable

Key Areas of Impact

Unified concept of operations

- Support the development of an interagency concept of operations, for consistency of technology adoption and programmatic alignment for national needs

Airspace management for near 24x7 continuous operations

- Integrate portable traffic management capabilities for common situational awareness
- Enable simultaneous and coordinated operations of diverse vehicles

Sensing, data fusion and models integration for better prediction

- Increase access to reliable surveillance data and fire prediction models for in-time decision-making
- Develop advanced sensor fusion and predictive models

Key Areas of Impact

Aircraft capabilities for safe operations in adverse environments

- Expand operational envelope with aircraft technologies for hazard avoidance and aircraft state management

Persistent, integrated, diverse airspace operations

- Develop system requirements, designs, and prototypes for persistent surveillance and airspace operations with a diverse and increased aerial response

Prior Research:

NASA-JAXA Collaboration of UAS Traffic Management for Emergency Response

Objectives

- Investigate the safe and efficient integration of UAS into disaster relief operations by leveraging NASA's UAS Traffic Management (UTM) System and JAXA's Disaster Relief Aircraft Information Sharing Network (D-NET) system

Approach

- Established connectivity between D-NET system in Japan and UTM system at NASA Ames enabling real-time data exchanges for international simulation and testing
- Participated in live, large-scale disaster drill in Japan with the flight of a helicopter and sUAS operations managed by an integrated D-NET/UTM system
- Established the use of UTM as a means for mission planning in an incident command center

Period of Performance: FY16-FY20 & FY22-FY25

Live view from Operations Center in Ehime, Japan of D-NET display with integrated UTM operations and response helicopter in flight as part of 2018 large-scale disaster drill

2019 Pilot assessment of UTM volume alignment with natural landmarks

Prior Research:

Scalable Traffic Management for Emergency Response Operations (STEReO)

Objectives

- Explore the feasibility of automated traffic management, innovative communication networks, and autonomous vehicle capabilities in wildfire operation

Approach

- Employ NASA expertise in communications, UAS Traffic Management (UTM), vehicle autonomy, and human factors
- Leverage partnerships for domain expertise and tools
- Demonstrate working prototypes for field-deployable traffic management and communication, asset tracking, situation awareness displays, and vehicle autonomy in partner-hosted wildfire training exercises

Period of Performance: FY20-FY22

US Forest Service National Aerial Supervision Training Academy (NASTA) in Mesa, AZ (Spring 2021)

CAL FIRE Aerial Supervision Academy (CASA) in Redding, CA (Spring 2021)

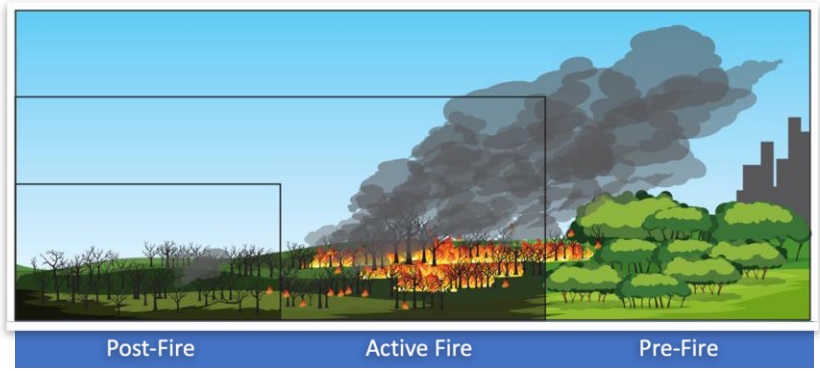
ACERO

Goal

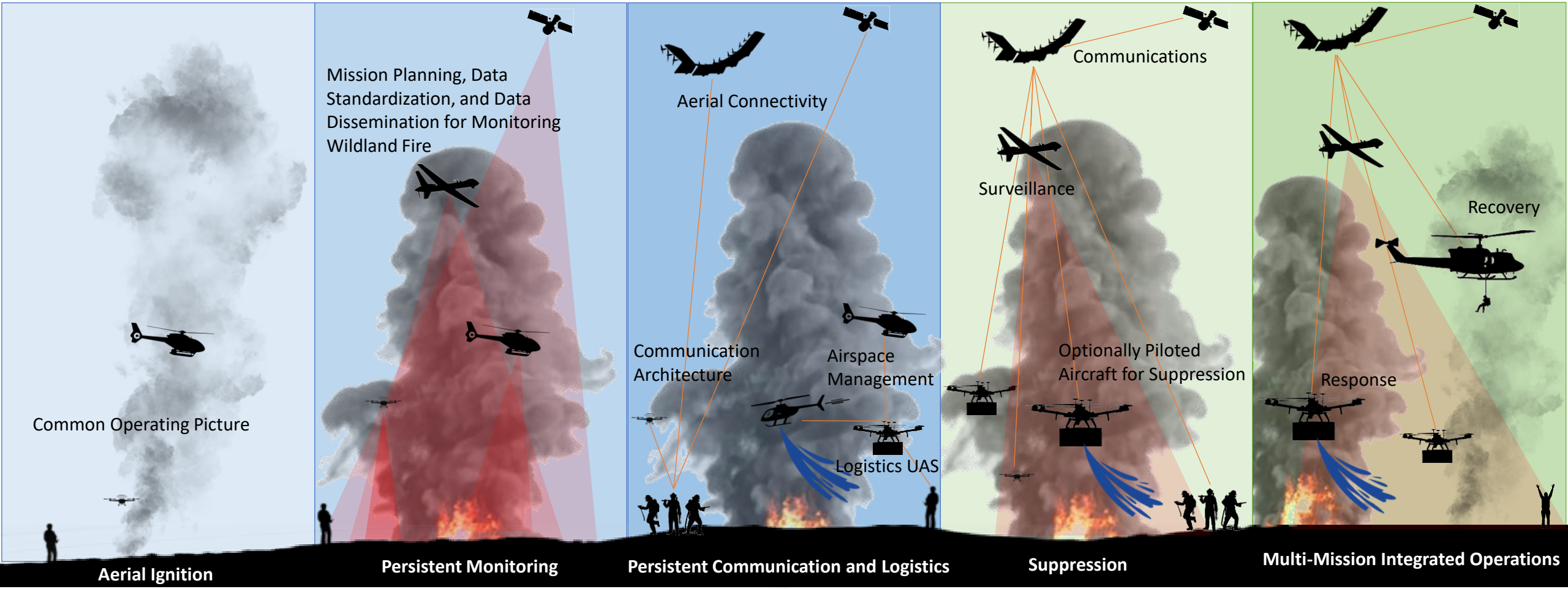
- Develop, integrate, demonstrate, and transition to operations, evolving NASA and industry aviation technologies to identify, monitor, and suppress wildland fires, as a means to enhance safety, improve efficiency of operations, and prevent economic loss

Objectives

- Demonstrate new airspace management technologies to improve safety and resource utilization during a disaster
- Demonstrate new mission capabilities using new aviation technologies that provide resilient and interoperable communication, navigation, surveillance, and mission support to disaster response operations
- Integrate NASA SMD Earth Science sensing capabilities and flight assets, with NASA ARMD airspace and vehicle capabilities to enable expanded and scalable operations
- Leverage public-private partnerships to develop and test prototype capabilities

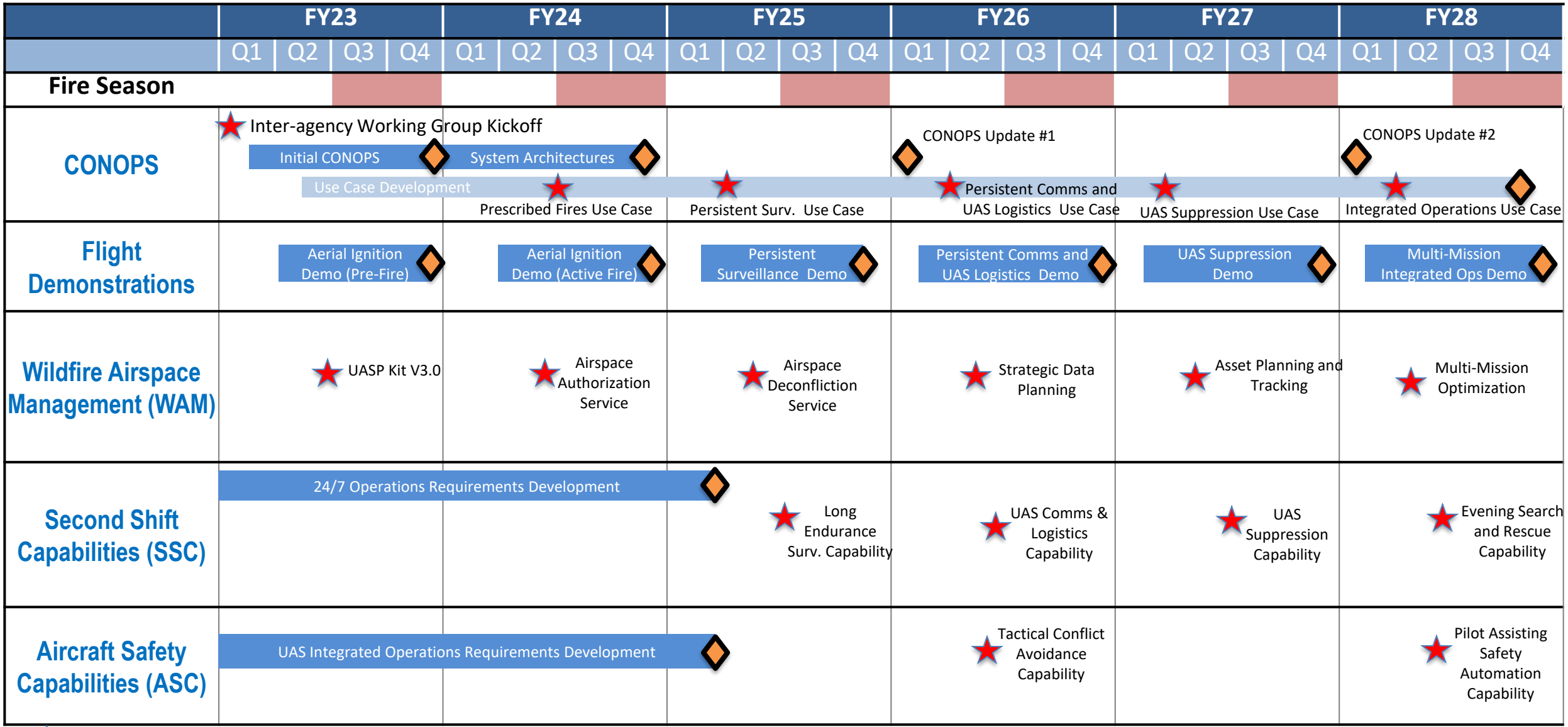


ACERO Use Cases



ACERO will focus on the identification, monitoring, and suppression of wildland fires by developing airspace management and aircraft capabilities for the safe integration of remotely and optionally piloted aircraft into wildland fire operations

ACERO Approach



Expected Outcomes

With improved sensing, modeling and data fusion:

- Improved reliability/availability to track and monitor wildland fires
- Increased precision of detected location
- Better data and validated models for predicting wildfire ignition and spread

With improved airspace management and aircraft technologies:

- Increased utilization of aircraft (existing and new platforms) across the incident
- Increased duration of aerial firefighting asset use – progress towards 24x7
- Reduced number of accidents and increased safety of operations

Questions?

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reference: presentation to NASA Advisory Council; August, 2022
marcus johnson – ACERO project manager

STEReO

origin

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Scalable Traffic Management for Emergency Response Operations

NASA

programmatic identity

- 2-year feasibility evaluation

motivation

- take UTM-like capabilities into the world of emergency response

mission statement

- combining NASA technologies and partnerships to transform current-day emergency response operations

problem

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emergency response operations aren't easy:

- conducted under adverse conditions
- involve numerous organizations
- limited communication and infrastructure
- manual coordination to deconflict/use airspace
- challenges with timeliness of information

the result? safe procedures with minimal technological advances

^^problem statement^^

opportunity

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use innovative communication approaches to enable new traffic management and autonomous vehicle capabilities, providing a data-rich common operating picture

the result? help responders do more, know more, safely

^^vision statement^^

pulse check

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stakeholder workshop (february. 2020)

- 45 attendees from 22 different organizations
- representatives from emergency response, tech industry, telecommunications, and public utilities
- 3-day event held at ARC that discussed:
  - current-day practices
  - new ideas/technologies worth pursuing
  - moving forward/next steps

approach

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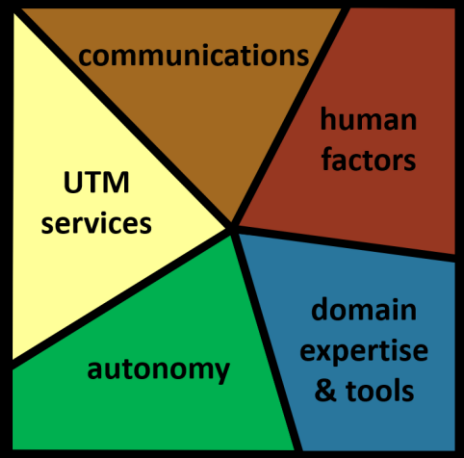
this overall team structure: ---------->



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this objective: “…to be evaluated during a flight demonstration at a partner-hosted event”

...led to an initial field test of STEReO software and comms hardware, used to simulate many aspects of the envisioned joint flight demonstration

NASTA

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- USFS National Aerial Supervision Training Academy (NASTA)
  - mesa, AZ
  - march 1 – 5, 2021
- simulated flight test
  - real-time ADS-B information from piloted USFS aircraft, simulated NASA sUAS vehicles, simulated ground assets, fused into a portable USS/comms package, and displayed in a common-operating picture
  - conducted as a sand-table exercise with flight crew, air attack, and division ‘actors’

NASTA

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[NASTA video]

CASA

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NASA

- CAL FIRE Aerial Supervision Academy (CASA)
  - redding, CA
  - may 4 – 6, 2021

- joint flight demonstration
  - live NASA sUAS vehicles, as well as piloted CAL FIRE aircraft
  - simulated NASA sUAS vehicles exercising functions of autonomy
  - HWITL ground-asset tracking, via prototype VHF solutions
  - …all fed into a portable USS/comms package, and displayed in a common-operating picture
  - conducted as a parallel training exercise with flight crew, air attack, and incident command actors

  - cloud-based USS-to-USS data exchanges were also tested to validate interoperability

CASA

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- Simulated NASA sUAS vehicles exercising functions of autonomy
  - NASA software integrated and tested for field operations
    - ICAROUS
      - Autonomous navigation to landing site
    - S2D
      - Autonomous landing from traffic conflict
    - WebGS
      - Automated operational-plan updates sent to USS, triggered by autonomy functions
    - Reflection
      - Autonomous payload-directed navigation

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Initial Airborne Assessment (IAA)

- Beaver Dam, VA
- June 23rd 2021

Crewed & Uncrewed Flight Demonstration

- Live NASA sUAS executing autonomous maneuvers, with piloted NASA aircraft
- Simulated NASA sUAS exercising USS data exchange
- Conducted to test end-to-end system integration in flight

sUAS Logistics

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UASP-kit

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UASP-kit

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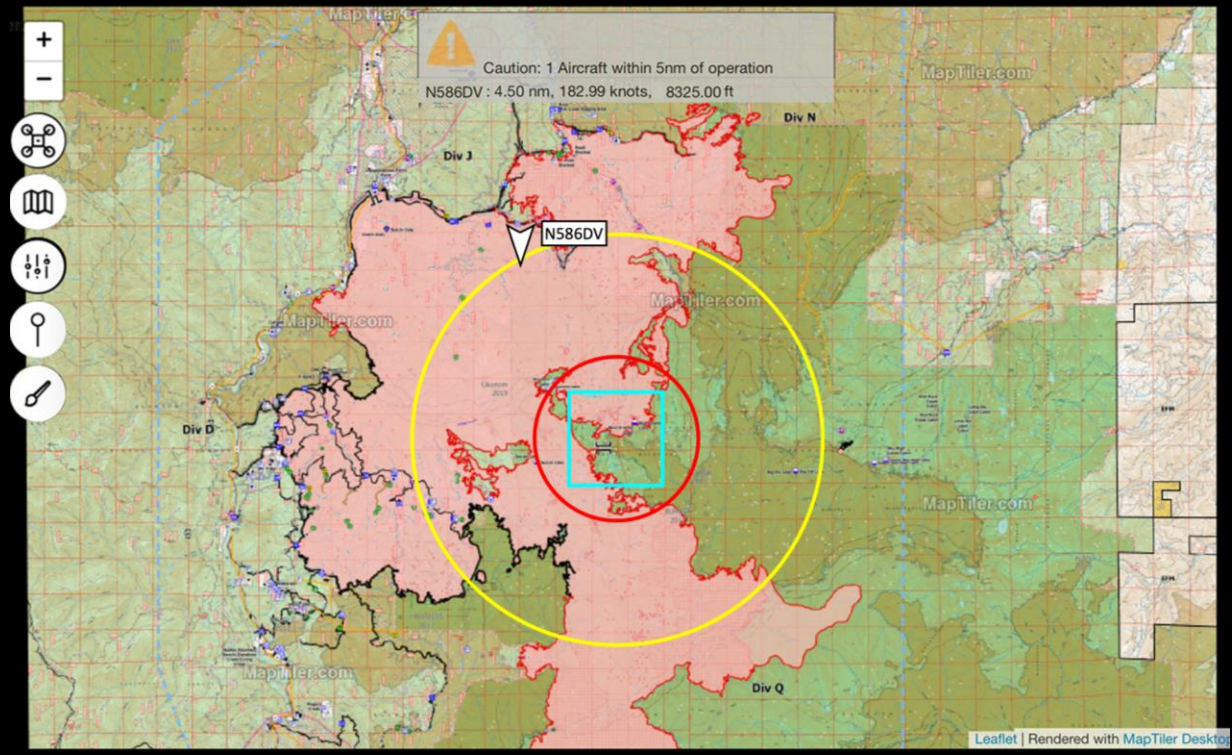
NASA

primary UI elements:

- base map
- imported ops map
- operational volume for UAS mission
- ADS-B tracks
- alerting rings w/ audible alerts



UASP-kit

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- first working prototype of the UASP-kit was field tested at the mccash fire in california's klamath NF

- second version of the UASP-kit was field tested at the aerial ignition academy in the southeast region

- sustained use in operationally-relevant environments
  - UASP-kits are in the hands of firefighters now, being used this fire season
    - USFS x4, CAL FIRE x1

questions?

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